

WHAT IS CLAIMED IS:

1. A duplexer comprising a laminate in which dielectric layers and electrode layers are laminated alternately, comprising:

- 5           a first filter for transmitting and a second filter for receiving, which are provided in the laminate and have different pass band frequencies; and  
          a matching circuit comprising a coupling line, having one end that is short-circuited and the other end that is connected to an external terminal, provided between the first filter and the second filter,  
10           wherein the first filter comprises at least one first stripline resonator, having one end that is short-circuited,  
          the second filter comprises at least one second stripline resonator, having one end that is short-circuited, and  
          the first stripline resonator and the second stripline resonator are  
15           coupled to the coupling line by electromagnetic field coupling.

2. The duplexer according to claim 1, wherein at least one of the first stripline resonator and the second stripline resonator has a large line width on an open end side and a small line width on a short-circuited side.

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3. The duplexer according to claim 1, wherein the laminate comprises a first dielectric layer, a second dielectric layer, a third dielectric layer, and a fourth dielectric layer laminated successively,

- the electrode layers include:  
25           a first shield electrode placed on an upper surface of the first dielectric layer;  
          an interstage coupling capacitive electrode comprising the first filter and an input/output coupling capacitive electrode comprising the second filter, placed between the first dielectric layer and the second dielectric layer;  
30           a first resonator electrode comprising the first filter, a second resonator electrode comprising the second filter, and a coupling line electrode comprising the matching circuit, placed between the second dielectric layer and the third dielectric layer;  
          an input/output coupling capacitive electrode comprising the first  
35           filter and an interstage coupling capacitive electrode comprising the second filter, placed between the third dielectric layer and the fourth dielectric layer;  
          a second shield electrode placed on a lower surface of the fourth

dielectric layer;

at least three terminal electrodes connected to the input/output coupling capacitive electrode comprising the first filter, the input/output coupling capacitive electrode comprising the second filter, and the coupling line electrode, respectively, provided on side surfaces of the first dielectric layer, the second dielectric layer, the third dielectric layer, and the fourth dielectric layer; and

an end face electrode connecting the first shield electrode and the second shield electrode to each other.

4. The duplexer according to claim 3, wherein at least one of the first dielectric layer, the second dielectric layer, the third dielectric layer, and the fourth dielectric layer has a dielectric constant different from that of the other dielectric layers.

5. The duplexer according to claim 1, wherein at least one of the first stripline resonator and the second stripline resonator is formed on a dielectric layer different from a dielectric layer on which the coupling line is formed.

6. The duplexer according to claim 1, wherein the coupling line comprises at least two striplines having different line widths, connected to each other.

7. The duplexer according to claim 1, wherein the coupling line comprises a plurality of striplines, and the plurality of striplines are provided on different dielectric layers.

8. The duplexer according to claim 7, wherein at least one of the plurality of striplines has a line width different from that of the other striplines.

9. The duplexer according to claim 7, wherein the plurality of striplines are connected to each other by a via hole.

10. The duplexer according to claim 1, further comprising a coupling capacitor provided so as to be overlapped with the coupling line and the stripline resonator with the dielectric layer interposed therebetween.

11. The duplexer according to claim 3, further comprising an adjusting

capacitive electrode provided so as to be opposed to the first shield electrode with the first dielectric layer interposed therebetween.

12. The duplexer according to claim 1, wherein the first filter and the second  
5 filter are provided so as to be opposed to each other with a shield electrode interposed therebetween.

13. The duplexer according to claim 12, wherein the laminate comprises a  
10 first dielectric layer, a second dielectric layer, a third dielectric layer, a fourth dielectric layer, a fifth dielectric layer, and a sixth dielectric layer laminated successively, and

the electrode layers include:

a first shield electrode placed on an upper surface of the first  
dielectric layer;

15 an interstage coupling capacitive electrode and an input/output coupling capacitive electrode comprising the first filter, placed between the first dielectric layer and the second dielectric layer;

a plurality of resonator electrodes comprising the first filter, placed  
between the second dielectric layer and the third dielectric layer;

20 a third shield electrode and a coupling line electrode comprising the matching circuit, placed between the third dielectric layer and the fourth dielectric layer;

a plurality of resonator electrodes and an input/output line electrode  
connected to the resonator electrodes comprising the second filter, placed  
25 between the fourth dielectric layer and the fifth dielectric layer;

an interstage coupling capacitive electrode comprising the second  
filter, placed between the fifth dielectric layer and the sixth dielectric layer;

a second shield electrode placed on a lower surface of the sixth  
dielectric layer;

30 at least three terminal electrodes connected to the input/output coupling capacitive electrode, the input/output line electrode, and the coupling line electrode, respectively, provided on side surfaces of the first dielectric layer, the second dielectric layer, the third dielectric layer, the fourth dielectric layer, the fifth dielectric layer, and the sixth dielectric layer;  
35 and

an end face electrode connecting the first shield electrode, the second shield electrode, and the third shield electrode to each other.

14. A duplexer comprising a laminate in which dielectric layers and electrode layers are laminated alternately, comprising:

5 a first shield electrode, a second shield electrode, a third shield electrode, and a fourth shield electrode arranged in the laminate in a lamination direction;

10 a first filter configured in such a manner that a plurality of stripline resonators, each having one end that is short-circuited, are adjacent to each other in parallel, placed between the first shield electrode and the second shield electrode;

a matching circuit comprising a coupling line, placed between the second shield electrode and the third shield electrode; and

15 a second filter that is configured in such a manner that a plurality of stripline resonators, each having one end that is short-circuited, are adjacent to each other in parallel and that has a pass band frequency different from that of the first filter, placed between the third shield electrode and the fourth shield electrode,

wherein the second and third shield electrodes are provided with coupling windows, and

20 the stripline resonators comprising the first and second filters and the coupling line are coupled to each other by electromagnetic field coupling via the coupling windows, respectively.

15. The duplexer according to claim 14, wherein the laminate comprises a first dielectric layer, a second dielectric layer, a third dielectric layer, a fourth dielectric layer, a fifth dielectric layer, a sixth dielectric layer, a seventh dielectric layer, and an eighth dielectric layer laminated successively,

the electrode layers include:

30 a first shield electrode placed on an upper surface of the first dielectric layer;

an interstage coupling capacitive electrode and an input/output coupling capacitive electrode comprising the first filter, placed between the first dielectric layer and the second dielectric layer;

35 a plurality of resonator electrodes comprising the first filter, placed between the second dielectric layer and the third dielectric layer;

a third shield electrode partially provided with the coupling window, placed between the third dielectric layer and the fourth dielectric layer;

a coupling line electrode comprising the matching circuit, placed between the fourth dielectric layer and the fifth dielectric layer;

a fourth shield electrode partially provided with the coupling window, placed between the fifth dielectric layer and the sixth dielectric layer;

5 a plurality of resonator electrodes and an input/output line electrode connected to the resonator electrodes comprising the second filter, placed between the sixth dielectric layer and the seventh dielectric layer;

an interstage coupling capacitive electrode comprising the second filter, placed between the seventh dielectric layer and the eighth dielectric layer;

10 a second shield electrode placed on a lower surface of the eighth dielectric layer;

at least three terminal electrodes connected to the input/output coupling capacitive electrode, the input/output line electrode, and the coupling line electrode, respectively, provided on side surfaces of the first dielectric layer, the second dielectric layer, the third dielectric layer, the fourth dielectric layer, the fifth dielectric layer, the sixth dielectric layer, the seventh dielectric layer, and the eighth dielectric layer; and

20 an end face electrode connecting the first shield electrode, the second shield electrode, the third shield electrode, and the fourth shield electrode to each other.

16. A duplexer comprising a laminate in which dielectric layers and electrode layers are laminated alternately, comprising:

25 a first filter for transmitting and a second filter for receiving, which are provided in the laminate and have different pass band frequencies; and

a matching circuit comprising a coupling line, having one end that is opened and the other end that is connected to an external terminal, provided between the first filter and the second filter,

30 wherein the first filter comprises at least one first stripline resonator, having one end that is short-circuited,

the second filter comprises at least one second stripline resonator, having one end that is short-circuited, and

35 the first stripline resonator and the second stripline resonator are coupled to the coupling line by electromagnetic field coupling.

17. The duplexer according to claim 16, wherein a matching capacitive

electrode is connected on an open end side of the coupling line with a dielectric layer interposed therebetween.

18. The duplexer according to claim 16, wherein at least one of the first  
5 stripline resonator and the second stripline resonator has a larger line width on an open end side and a smaller line width on a short-circuited end side.

19. The duplexer according to claim 16, wherein the laminate comprises a  
10 first dielectric layer, a second dielectric layer, a third dielectric layer, and a fourth dielectric layer laminated successively, and

the electrode layers include:

a first shield electrode placed on an upper surface of the first  
dielectric layer;

an interstage coupling capacitive electrode comprising the first filter  
15 and an input/output coupling capacitive electrode comprising the second filter, placed between the first dielectric layer and the second dielectric layer;

a first resonator electrode comprising the first filter, a second  
resonator electrode comprising the second filter, and a coupling line electrode  
20 comprising the matching circuit, placed between the second dielectric layer and the third dielectric layer;

an input/output coupling capacitive electrode comprising the first  
filter and an interstage coupling capacitor electrode comprising the second  
filter, placed between the third dielectric layer and the fourth dielectric layer;

25 a second shield electrode placed on a lower surface of the fourth dielectric layer;

at least three terminal electrodes connected to the input/output  
coupling capacitive electrode comprising the first filter, the input/output  
coupling capacitive electrode comprising the second filter, and the coupling  
line electrode, respectively, provided on side surfaces of the first dielectric  
30 layer, the second dielectric layer, the third dielectric layer, and the fourth dielectric layer; and

an end face electrode connecting the first shield electrode and the  
second shield electrode to each other.

35 20. The duplexer according to claim 19, wherein at least one of the first dielectric layer, the second dielectric layer, the third dielectric layer, and the fourth dielectric layer has a dielectric constant different from that of the

other dielectric layers.

21. The duplexer according to claim 16, wherein at least one of the first  
stripline resonator and the second stripline resonator is formed on a dielectric  
5 layer different from a dielectric layer on which the coupling line is formed.

22. The duplexer according to claim 16, wherein the coupling line comprises  
at least two striplines having different line widths, connected to each other.

10 23. The duplexer according to claim 16, wherein the coupling line comprises  
a plurality of striplines, and the plurality of striplines are provided on  
different dielectric layers.

24. The duplexer according to claim 23, wherein at least one of the plurality  
15 of striplines has a line width different from that of the other striplines.

25. The duplexer according to claim 23, wherein the plurality of striplines  
are connected to each other by a via hole.

20 26. The duplexer according to claim 16, further comprising a coupling  
capacitor provided so as to be overlapped with the coupling line and the  
stripline resonator with the dielectric layer interposed therebetween.

27. The duplexer according to claim 19, further comprising an adjusting  
25 capacitive electrode provided so as to be opposed to the first shield electrode  
with the first dielectric layer interposed therebetween.

28. The duplexer according to claim 16, wherein the first filter and the  
second filter are provided so as to be opposed to each other with a shield  
30 electrode interposed therebetween.

29. The duplexer according to claim 28, wherein the laminate comprises a  
first dielectric layer, a second dielectric layer, a third dielectric layer, a fourth  
dielectric layer, a fifth dielectric layer, and a sixth dielectric layer laminated  
35 successively, and

the electrode layers include:

a first shield electrode placed on an upper surface of the first

dielectric layer;

an interstage coupling capacitive electrode and an input/output coupling capacitive electrode comprising the first filter, placed between the first dielectric layer and the second dielectric layer;

5 a plurality of resonator electrodes comprising the first filter, placed between the second dielectric layer and the third dielectric layer;

a third shield electrode and a coupling line electrode comprising the matching circuit, placed between the third dielectric layer and the fourth dielectric layer;

10 a plurality of resonator electrodes and an input/output line electrode connected to the resonator electrodes comprising the second filter, placed between the fourth dielectric layer and the fifth dielectric layer;

an interstage coupling capacitive electrode comprising the second filter, placed between the fifth dielectric layer and the sixth dielectric layer;

15 a second shield electrode placed on a lower surface of the sixth dielectric layer;

at least three terminal electrodes connected to the input/output coupling capacitive electrode, the input/output line electrode, and the coupling line electrode, respectively, provided on side surfaces of the first dielectric layer, the second dielectric layer, the third dielectric layer, the fourth dielectric layer, the fifth dielectric layer, and the sixth dielectric layer; and

20 an end face electrode connecting the first shield electrode, the second shield electrode, and the third shield electrode to each other.

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30. A duplexer comprising a laminate in which dielectric layers and electrode layers are laminated alternately, comprising:

a first filter for transmitting and a second filter for receiving, which are provided in the laminate and have different pass band frequencies; and

30 a matching circuit comprising a coupling line, provided between the first filter and the second filter,

wherein at least one of the first and second filters is a filter comprising a stripline resonator, having one end that is short-circuited, and a transmission line, having a band elimination characteristics, and

35 the transmission line and the coupling line are coupled to each other by electromagnetic field coupling.



31. The duplexer according to claim 30, wherein the laminate comprises a first dielectric layer, a second dielectric layer, a third dielectric layer, a fourth dielectric layer, and a fifth dielectric layer laminated successively, and

the electrode layers include:

5 a first shield electrode placed on an upper surface of the first dielectric layer;

an interstage coupling capacitive electrode comprising the first filter, placed between the first dielectric layer and the second dielectric layer;

10 a plurality of resonator electrodes comprising the first filter and a coupling line electrode comprising the matching circuit, placed between the second dielectric layer and the third dielectric layer;

15 an input/output coupling capacitive electrode comprising the first filter, a transmission line electrode comprising the second filter, having band elimination characteristics, and a coupling line electrode comprising a matching circuit, placed between the third dielectric layer and the fourth dielectric layer;

a resonator electrode comprising the second filter, placed between the fourth dielectric layer and the fifth dielectric layer;

20 a second shield electrode placed on a lower surface of the fifth dielectric layer;

at least three terminal electrodes connected to the input/output coupling capacitive electrode, the transmission line electrode, and the coupling line electrode, respectively, provided on side surfaces of the first dielectric layer, the second dielectric layer, the third dielectric layer, the fourth dielectric layer, and the fifth dielectric layer; and

25 an end face electrode connecting the first shield electrode and the second shield electrode to each other.

32. The duplexer according to claim 30, wherein the laminate comprises a first dielectric layer, a second dielectric layer, a third dielectric layer, a fourth dielectric layer, and a fifth dielectric layer laminated successively, and

the electrode layers include:

a first shield electrode placed on an upper surface of the first dielectric layer;

35 an interstage coupling capacitive electrode comprising the first filter, placed between the first dielectric layer and the second dielectric layer;

a plurality of resonator electrodes comprising the first filter and a

coupling line electrode comprising the matching circuit, placed between the second dielectric layer and the third dielectric layer;

an input/output coupling capacitive electrode comprising the first filter and a transmission line electrode comprising the second filter, having  
5 band elimination characteristics, placed between the third dielectric layer and the fourth dielectric layer;

a resonator electrode comprising the second filter, placed between the fourth dielectric layer and the fifth dielectric layer;

a second shield electrode placed on a lower surface of the fifth  
10 dielectric layer;

at least three terminal electrodes connected to the input/output coupling capacitive electrode, the transmission line electrode, and the coupling line electrode, respectively, provided on side surfaces of the first dielectric layer, the second dielectric layer, the third dielectric layer, the  
15 fourth dielectric layer, and the fifth dielectric layer; and

an end face electrode connecting the first shield electrode and the second shield electrode to each other,

a part of the transmission line electrode is overlapped with the coupling line electrode with the third dielectric layer interposed therebetween  
20 in a projection in a lamination direction, and

in the projection in the lamination direction, a width of the part of the transmission line electrode is the same as or different from that of the coupling line electrode.

25 33. A laminate-type high-frequency device, comprising:

a duplexer comprising a laminate in which dielectric layers and electrode layers are laminated alternately; and

a semiconductor chip and/or a surface acoustic wave device mounted on an upper surface of the laminate,

30 wherein, as the duplexer, the duplexer of any one of claims 1 to 32 is used.

34. Communication equipment, comprising:

an antenna; and

35 a duplexer for transmitting a frequency component output from a transmitting circuit to the antenna and transmitting a frequency component received from the antenna to a receiving circuit, comprising a laminate in

which dielectric layers and electrode layers are laminated alternately,  
wherein, as the duplexer, the duplexer of any one of claims 1 to 32 is  
used.

- 5 35. Communication equipment according to claim 34, further comprising at  
least one selected from a semiconductor chip and a surface acoustic wave  
device mounted on an upper surface of the laminate.